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Margaret A. Witherill  
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DOE, RFFO

FOCUSED RISK ASSESSMENTS OF OU 7 SEEP WATER, POND WATER AND POND SEDIMENTS -  
LJP-009-95

Action: Information Only.

Attached please find a focused Human Health Risk Assessment performed for surface waters and sediments in the East Landfill Pond. Three separate residential exposure scenarios were assessed.

If you have any questions regarding this transmittal, please feel free to contact me at extension 8553.

  
Laurie J. Peterson-Wright  
Operable Unit 7 Project Manager  
OU 5, 6, & 7 Closures

LJPW:cb

Orig. and 1 cc - M. A. Witherill

Attachment:  
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## HUMAN HEALTH RISK ASSESSMENT FOR THE OPERABLE UNIT 7 EAST LANDFILL POND

### Introduction

A Human Health Risk Assessment (HHRA) was performed for surface waters and sediments in the East Landfill Pond in Operable Unit 7 (OU7) (see Figure 1). Three separate residential exposure scenarios were assessed. Risks were assessed for a resident drinking pond water, swimming in the pond, or exposed to pond sediments during recreational activity. The first exposure scenario assumed that a resident drank directly from a surface seep at OU7 located at SW097 or surface water sampled at SW098. The second exposure scenario assumed that a resident infrequently swims at OU7 and incidentally ingests the water from the surface seep located at SW097 and from the surface water located at SW098. The third scenario assumed human receptors were exposed to pond sediments under the residential recreational exposure scenario. The maximum contaminant concentration and the average contaminant concentration were used for the exposure concentrations.

The results of the risk assessment are outlined in Attachment 1. The risk from a resident directly drinking seep water is considerably higher than the risk from directly drinking pond surface water. Although the risks from directly drinking seep water are higher, they are not far from the acceptable risk range ( $10^{-6}$  to  $10^{-4}$ ). Risks for the resident swimming in either seep water or surface water are within the acceptable range.

Based on the analysis of pond sediment data from one sampling round at each of three sediment collection stations in the landfill pond, no chemicals of concern were identified. Therefore, no risk assessment was conducted for this exposure scenario. All contaminant concentrations were reviewed for use and were taken from the Operable Unit No. 7 Final Work Plan, dated September 2, 1994.

### Methodology

The data for this risk assessment were taken from the Operable Unit No. 7 Final Work Plan, Volume IV - Appendices L-P. All data were examined for use in the risk assessment. Two screening steps were performed on the data before it was used to estimate risks. The first screen was a background comparison for inorganic constituents. The maximum detection for an inorganic analyte was compared to the Upper Tolerance Limit ( $UTL_{99/99}$ ) from the background data set. If the maximum detection of an analyte was less than the  $UTL_{99/99}$ , the analyte was dropped from further consideration. If the maximum concentration was larger than the  $UTL_{99/99}$ , then the analyte was evaluated with a second screen. The second screen was a comparison with Programmatic Preliminary Remediation Goals (PPRG). PPRGs were taken from the latest revision of the Programmatic Risk-Based Preliminary Remediation Goals (DOE, February 1995)

document developed for use in environmental remediation activities. PPRGs are based on a target risk of  $10^{-6}$  or a hazard index (HI) of 1. The PPRG derived for a resident directly drinking ground water was used for this comparison since this scenario is equally applicable to the direct ingestion of surface water. If the maximum detection of an analyte fell below the PPRG, the analyte was dropped from further consideration. If the maximum concentration was larger than the PPRG, the analyte was assessed in the risk assessment. Organic constituents were only compared to PPRGs.

The methodology used to select the sediment COCs for the OU7 landfill pond varied from that used for the surface water medium. No background data for pond sediments were available from the sitewide background study (DOE, 1994). As with the background comparisons for OU5 and OU6, pond sediment data were compared to background data from seep and spring sediments. The decision to make this comparison instead of a comparison to background stream sediment data was based on geophysical differences in these fluvial systems. Concentrations of inorganics tend to be lower in stream sediments than in pond or seep/spring sediments because sediments are transported in streams and accumulate in the calmer waters of ponds, seeps, and springs. The conservative assumption was made that the background data are normally distributed. For example, the  $UTL_{99/99}$  for zinc assuming a normal distribution is 148 mg/kg compared to 302 mg/kg for a lognormal distribution.

Sediment PPRGs for the residential recreational exposure scenario were not developed for the sitewide PPRG document (DOE, February 1995). Rather, the exposure factors for the sediment exposure scenario were first developed for and discussed in the 14 November 1994 letter to Jessie Roberson, DOE RFFO from Sue Stiger, EG&G ERPD (Correspondence #94-RF-11444). The equations for calculating these PPRGs are presented in Attachment 2. The RME PPRGs were used for comparison with the maximum analyte concentrations. For the most part, the maximum concentrations were found in the sediment sample collected at location SED70093, at the west end of the pond (Figure 1). In general, organic compounds were not detected in the sediment samples collected at SED70193 and SED70293.

The risks were calculated for both average and maximum concentrations. This provides the range of potential exposures to be examined. The average contaminant concentration is the best indicator of chronic exposure to contaminants present, while the maximum contaminant concentration gives a high end estimate of the potential risks from the site. For data that were qualified as a non-detect, one-half the reported value was used to calculate the average concentration.

The methodology used to assess risks was taken from EPA's Risk Assessment Guidance For Superfund, Volume I, Human Health Evaluation Manual (Part A) (1989). The residential scenario was taken directly from this methodology. The drinking water pathway was chosen since the risk from this pathway defines the upper bound. Oral slope factors and oral reference doses were taken from the Programmatic Risk-Based Preliminary Remediation Goals document which includes a compilation of current toxicity factor information. For expediency, radionuclide carcinogenic risk was added to the carcinogenic risks from chemicals and metals.

## Results

The risk assessment calculations and the risk assessment results are outlined in Attachment 3 through Attachment 6. Attachment 1 is a summary table of the risk assessments performed. There may be unacceptable risks to persons drinking 2 liters of seep water per day for 30 years. The risks calculated using maximum concentrations are not far above the acceptable carcinogenic risk range of  $10^{-6}$  to  $10^{-4}$  and the acceptable HI of 1.

Attachment 3 gives a breakdown of the sources of risks for a resident using the surface water at SW098 as his sole drinking water supply. If only the maximum contaminant concentrations are used for this analysis, a carcinogenic risk of  $7\text{E-}07$  and a hazard index of  $4\text{E-}03$  is calculated. These risks are well within the range of acceptable risks. If the average value is used in the calculation, a carcinogenic risk of  $3\text{E-}7$  and an HI of  $1\text{E-}03$  is seen.

Attachment 4 outlines the risks for a resident who swims in the surface water around SW098. The risks due to the maximum concentrations are  $9\text{E-}10$  for the carcinogenic risk and  $5\text{E-}06$  for the HI. These risks are well within the range of acceptable risks. The risks using the average contaminant concentration are  $3\text{E-}10$  and  $2\text{E-}06$  for the carcinogenic risk and the HI, respectively.

Attachment 5 gives the risks for a resident using the seep water at SW097 as his sole drinking water supply. None of the risks calculated in this scenario are within the acceptable range. The carcinogenic risks are  $1\text{E-}04$  and  $3\text{E-}04$  from the average and maximum contaminant concentrations, respectively. The hazard indices are  $9\text{E+}00$  and  $2\text{E+}01$  from the average and maximum contaminant concentrations, respectively.

The risks of someone swimming in seep water from SW097 are given in Attachment 6. All risks calculated are within the acceptable risk range. The carcinogenic risks are  $2\text{E-}07$  and  $4\text{E-}07$  from the average and maximum contaminant concentrations, respectively. The HIs are  $1\text{E-}02$  and  $2\text{E-}02$  from the average and maximum contaminant concentrations, respectively.

Attachment 7 presents the selection of sediment COCs for the OU7 landfill pond. As shown in this table, the maximum concentrations of inorganic constituents are below the conservative (normal distribution assumption) background  $\text{UTL}_{99/99}$  for all analytes except zinc. Statistical comparisons to background (Gilbert methodology) could not be made due to the small sample size (one sediment sample collected at each of three pond locations). The maximum concentrations of each organic constituent and zinc were then compared to the sediment PPRGs developed for the residential recreational scenario; no PPRGs were exceeded.

**OPERABLE UNIT 7 SEEP WATER & SURFACE WATER INGESTION RISK**

Attachment 1

**SUMMARY TABLES**

Receptor: Residential

Area Description: OU 7 Surface Water and Seep Water Ingestion Scenario

	Average Concentration		Maximum Concentration	
Media\Pathway	Carcinogenic Risk	Chronic Hazard Index	Carcinogenic Risk	Chronic Hazard Index
<u>Surface Water (SW098)</u>				
Residential Direct Ingestion	2.64E-07	1.37E-03	7.05E-07	3.65E-03
Residential Trespasser (Swimming)	3.43E-10	1.78E-06	9.16E-10	4.75E-06
<u>Surface Seep (SW097)</u>				
Residential Direct Ingestion	1.24E-04	9.10E+00	2.71E-04	1.52E+01
Residential Trespasser (Swimming)	1.61E-07	1.18E-02	3.52E-07	1.97E-02

# ATTACHMENT 2 PPRG EQUATIONS FOR EXPOSURE TO SEDIMENTS UNDER THE RESIDENTIAL RECREATIONAL SCENARIO

The following equations are based on those presented in the PPRG document for exposure to surficial soils, but are adjusted to account for the hypothetical resident that spends time playing in the OU7 landfill pond. The equation for radionuclides is as follows:

$$PPRG_r = \frac{TR}{ED \times [(EF \times IR_o \times SF_o \times 10^{-3} \text{ g/mg}) + (EF \times IR_i \times SF_i \times 10^3 \text{ g/kg} \times 1/PEF) + (SF_e \times (1-S_e) \times T_e)]}$$

Where:

PPRG <sub>r</sub>	=	Risk-based PPRG for sediment based on residential/recreational use (pCi/g)
TR	=	Target excess lifetime cancer risk (10 <sup>-6</sup> )
ED	=	Exposure duration (30 years)
EF	=	Exposure frequency (7 days/year)
IR <sub>o</sub>	=	Sediment ingestion rate (50 mg/day)
SF <sub>o</sub>	=	Oral cancer slope factor (pCi) <sup>-1</sup>
IR <sub>i</sub>	=	Inhalation rate (2 m <sup>3</sup> /day)
SF <sub>i</sub>	=	Inhalation cancer slope factor (pCi) <sup>-1</sup>
PEF	=	Particulate emission factor (4.63E+09 m <sup>3</sup> /kg)
SF <sub>e</sub>	=	External exposure slope factor (risk/yr per pCi/g)
S <sub>e</sub>	=	Gamma shielding factor (0.2)
T <sub>e</sub>	=	Gamma exposure factor (0.3)

The equation for nonradionuclide carcinogens is as follows:

$$PPRG_c = \frac{TR \times BW \times AT}{ED \times EF \times [(IR_o \times SF_o \times 10^{-6} \text{ kg/mg}) + (IR_i \times SF_i \times 1/PEF)]}$$

Where:

PPRG <sub>c</sub>	=	Risk-based PPRG for sediment based on residential recreational use (mg/kg)
TR	=	Target excess lifetime cancer risk (10 <sup>-6</sup> )
ED	=	Exposure duration (30 years)
EF	=	Exposure frequency (7 days/year)
IR <sub>o</sub>	=	Sediment ingestion rate (50 mg/day)
SF <sub>o</sub>	=	Oral slope factor (mg/kg-day) <sup>-1</sup>
IR <sub>i</sub>	=	Inhalation rate (2 m <sup>3</sup> /day)
SF <sub>i</sub>	=	Inhalation cancer slope factor (mg/kg-day) <sup>-1</sup>
PEF	=	Particulate emission factor (4.63E+09 m <sup>3</sup> /kg)
BW	=	Body weight (70 kg)

AT = Averaging time (25550 days)

The equation for noncarcinogenic compounds is as follows:

$$\text{PPRG}_n = \frac{\text{THI} \times \text{BW} \times \text{AT}}{\text{ED} \times \text{EF} \times [(\text{IR}_o \times 10^{-6} \text{ kg/mg} \times 1/\text{RfD}_o) + (\text{IR}_i \times 1/\text{PEF} \times 1/\text{RfD}_i)]}$$

Where:

PPRG <sub>n</sub>	=	Risk-based PPRG for sediment based on residential recreational use (mg/kg)
THI	=	Target hazard index (1)
ED	=	Exposure duration (30 years)
EF	=	Exposure frequency (7 days/year)
IR <sub>o</sub>	=	Sediment ingestion rate (50 mg/day)
RfD <sub>o</sub>	=	Oral reference dose (mg/kg-day)
IR <sub>i</sub>	=	Inhalation rate (2 m <sup>3</sup> /day)
SF <sub>i</sub>	=	Inhalation cancer slope factor (mg/kg-day)
PEF	=	Particulate emission factor (4.63E+09 m <sup>3</sup> /kg)
BW	=	Body weight (70 kg)
AT	=	Averaging time (10950 days)



OPERABLE UNIT 7 SEEP WATER & SURFACE WATER INGESTION RISK

Attachment 3

RISK ASSESSMENT PATHWAY ANALYSIS

Receptor: Residential  
Area Description: Surface Water Location (SW098)  
Media: Surface Water  
Pathway: Ingestion

Chemical Intake Factor =  $\frac{[(IR)(EF)(ED)]}{[(BW)(AT)]}$

Radionuclide Intake Factor =  $\frac{[(IR)(EF)(ED)]}{[(BW)(AT)]}$

		Reasonable Maximum Exposure Parameters
Exposure Factors Description	Chemical Units	Adult Exposure Values
Water Chemical Concentration (CW)	mg/liter or $\mu\text{Ci/liter}$	
Ingestion Rate (IR)	liter/day	2
Exposure Frequency (EF)	days/year	350
Exposure Duration (ED)	years	30
Body Weight (BW)	kg	70
Carcinogenic Averaging Time (AT)	days	25550
Noncarcinogenic Averaging Time (AT)	days	10950

CARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Methylene Chloride	0.003	1.17E-02	3.52E-05	7.50E-03	2.64E-07
TOTAL					2.64E-07

CARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Methylene Chloride	0.008	1.17E-02	9.39E-05	7.50E-03	7.05E-07
TOTAL					7.05E-07

NONCARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene Chloride	0.003	2.74E-02	8.22E-05	6.00E-02	1.37E-03
HAZARD INDEX					1.37E-03

NONCARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene Chloride	0.008	2.74E-02	2.19E-04	6.00E-02	3.65E-03
HAZARD INDEX					3.65E-03

OPERABLE UNIT 7 SEEP WATER & SURFACE WATER INGESTION RISK

Attachment 4

RISK ASSESSMENT PATHWAY ANALYSIS

Receptor: Residential Trespasser (Swimming)  
Area Description: Surface Water Location (SW098)  
Media: Surface Water  
Pathway: Ingestion

Chemical Intake Factor =  $[(IR)(ET)(EF)(ED)]/[BW)(AT)]$

Radionuclide Intake Factor =  $[(IR)(ET)(EF)(ED)]$

		Reasonable Maximum Exposure Parameters
Exposure Factors Description	Chemical Units	Adult Exposure Values
Water Chemical Concentration (CW)	mg/liter or $\mu\text{Ci}/\text{liter}$	
Ingestion Rate (IR)	liter/hr	0.05
Exposure Time (ET)	hr/event	2.6
Exposure Frequency (EF)	events/year	7
Exposure Duration (ED)	years	30
Body Weight (BW)	kg	70
Carcinogenic Averaging Time (AT)	days	25550
Noncarcinogenic Averaging Time (AT)	days	10950

CARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Methylene Chloride	0.003	1.53E-05	4.58E-08	7.50E-03	3.43E-10
TOTAL					3.43E-10

CARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Methylene Chloride	0.008	1.53E-05	1.22E-07	7.50E-03	9.16E-10
TOTAL					9.16E-10

NONCARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene Chloride	0.003	3.56E-05	1.07E-07	6.00E-02	1.78E-06
HAZARD INDEX					1.78E-06

NONCARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene Chloride	0.008	3.56E-05	2.85E-07	6.00E-02	4.75E-06
HAZARD INDEX					4.75E-06

**OPERABLE UNIT 7 SEEP WATER & SURFACE WATER INGESTION RISK**

Attachment 5

**RISK ASSESSMENT PATHWAY ANALYSIS**

Receptor: Residential  
 Area Description: Surface Seep Location (SW097)  
 Media: Seep Water  
 Pathway: Ingestion

Chemical Intake Factor =  $[(IR)(EF)(ED)]/[(BW)(AT)]$

Radionuclide Intake Factor =  $[(IR)(EF)(ED)]$

		Reasonable Maximum Exposure Parameters
Exposure Factors Description	Chemical Units	Adult Exposure Values
Water Chemical Concentration (CW)	mg/liter or pCi/liter	
Ingestion Rate (IR)	liter/day	2
Exposure Frequency (EF)	days/year	350
Exposure Duration (ED)	years	30
Body Weight (BW)	kg	70
Carcinogenic Averaging Time (AT)	days	25550
Noncarcinogenic Averaging Time (AT)	days	10950

**CARCINOGENIC RISK (AVERAGE EXPOSURE)**

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day) or (pCi)	Oral Slope Factor (mg/kg/day) <sup>-01</sup> or (pCi) <sup>-01</sup>	Carcinogenic Risk
Benzene	0.0019	1.17E-02	2.23E-05	2.90E-02	6.47E-07
Chloromethane	0.0051	1.17E-02	5.99E-05	1.30E-02	7.78E-07
Methylene Chloride	0.015	1.17E-02	1.76E-04	7.50E-03	1.32E-06
Trichloroethylene	0.0022	1.17E-02	2.58E-05	1.10E-02	2.84E-07
Vinyl Chloride	0.0053	1.17E-02	6.22E-05	1.90E+00	1.18E-04
Manganese	1.61	1.17E-02	1.89E-02	NTF	
Zinc	2.95	1.17E-02	3.46E-02	NTF	
Plutonium-238 (pCi/liter)	0.0009	2.10E+04	1.89E+01	2.20E-10	4.16E-09
Radium-226 (pCi/liter)	0.58	2.10E+04	1.22E+04	1.20E-10	1.46E-06
H-3 (pCi/liter)	331.3	2.10E+04	6.96E+06	5.40E-14	3.76E-07
Uranium-233,234 (pCi/liter)	0.73	2.10E+04	1.53E+04	1.60E-11	2.45E-07
Uranium-238 (pCi/liter)	0.59	2.10E+04	1.24E+04	2.00E-11	2.48E-07
TOTAL					1.24E-04

**CARCINOGENIC RISK (MAXIMUM EXPOSURE)**

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Benzene	0.002	1.17E-02	2.35E-05	2.90E-02	6.81E-07
Chloromethane	0.007	1.17E-02	8.22E-05	1.30E-02	1.07E-06
Methylene Chloride	0.19	1.17E-02	2.23E-03	7.50E-03	1.67E-05
Trichloroethylene	0.004	1.17E-02	4.70E-05	1.10E-02	5.17E-07
Vinyl Chloride	0.011	1.17E-02	1.29E-04	1.90E+00	2.45E-04
Manganese	2.49	1.17E-02	2.92E-02	NTF	
Zinc	16	1.17E-02	1.88E-01	NTF	
Plutonium-238 (pCi/liter)	0.0022	2.10E+04	4.62E+01	2.20E-10	1.02E-08
Radium-226 (pCi/liter)	0.58	2.10E+04	1.22E+04	1.20E-10	1.46E-06
H-3 (pCi/liter)	1500	2.10E+04	3.15E+07	5.40E-14	1.70E-06
Uranium-233,234 (pCi/liter)	4.2	2.10E+04	8.82E+04	1.60E-11	1.41E-06
Uranium-238 (pCi/liter)	3.76	2.10E+04	7.90E+04	2.00E-11	1.58E-06
TOTAL					2.71E-04

# RISK ASSESSMENT PATHWAY ANALYSIS

Attachment 5

## NONCARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	0.0019	2.74E-02	5.21E-05	NTF	6.85E-03
Chloromethane	0.0051	2.74E-02	1.40E-04	NTF	
Methylene Chloride	0.015	2.74E-02	4.11E-04	6.00E-02	
Trichloroethylene	0.0022	2.74E-02	6.03E-05	NTF	
Vinyl Chloride	0.0053	2.74E-02	1.45E-04	NTF	
Manganese	1.61	2.74E-02	4.41E-02	5.00E-03	8.82E+00
Zinc	2.95	2.74E-02	8.08E-02	3.00E-01	2.69E-01
HAZARD INDEX					9.10E+00

## NONCARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	0.002	2.74E-02	5.48E-05	NTF	8.68E-02
Chloromethane	0.007	2.74E-02	1.92E-04	NTF	
Methylene Chloride	0.19	2.74E-02	5.21E-03	6.00E-02	
Trichloroethylene	0.004	2.74E-02	1.10E-04	NTF	
Vinyl Chloride	0.011	2.74E-02	3.01E-04	NTF	
Manganese	2.49	2.74E-02	6.82E-02	5.00E-03	1.36E+01
Zinc	16	2.74E-02	4.38E-01	3.00E-01	1.46E+00
HAZARD INDEX					1.52E+01

NTF - No Toxicity Factor Available

**OPERABLE UNIT 7 SEEP WATER & SURFACE WATER INGESTION RISK**

Attachment 6

**RISK ASSESSMENT PATHWAY ANALYSIS**

Receptor: Residential Trespasser (Swimming)  
 Area Description: Surface Seep Location (SW097)  
 Media: Seep Water  
 Pathway: Ingestion

Chemical Intake Factor =  $[(IR)(ET)(EF)(ED)]/[BW(AT)]$

Radionuclide Intake Factor =  $[(IR)(ET)(EF)(ED)]$

		Reasonable Maximum Exposure Parameters
Exposure Factors Description	Chemical Units	Adult Exposure Values
Water Chemical Concentration (CW)	mg/liter or pCi/liter	
Ingestion Rate (IR)	liter/hr	0.05
Exposure Time (ET)	hr/event	2.6
Exposure Frequency (EF)	events/year	7
Exposure Duration (ED)	years	30
Body Weight (BW)	kg	70
Carcinogenic Averaging Time (AT)	days	25550
Noncarcinogenic Averaging Time (AT)	days	10950

**CARCINOGENIC RISK (AVERAGE EXPOSURE)**

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day) or (pCi)	Oral Slope Factor (mg/kg/day) <sup>-01</sup> or (pCi) <sup>-01</sup>	Carcinogenic Risk
Benzene	0.0019	1.53E-05	2.90E-08	2.90E-02	8.41E-10
Chloromethane	0.0051	1.53E-05	7.78E-08	1.30E-02	1.01E-09
Methylene Chloride	0.015	1.53E-05	2.29E-07	7.50E-03	1.72E-09
Trichloroethylene	0.0022	1.53E-05	3.36E-08	1.10E-02	3.69E-10
Vinyl Chloride	0.0053	1.53E-05	8.09E-08	1.90E+00	1.54E-07
Manganese	1.61	1.53E-05	2.46E-05	NTF	
Zinc	2.95	1.53E-05	4.50E-05	NTF	
Plutonium-238 (pCi/liter)	0.0009	2.73E+01	2.46E-02	2.20E-10	5.41E-12
Radium-226 (pCi/liter)	0.58	2.73E+01	1.58E+01	1.20E-10	1.90E-09
H-3 (pCi/liter)	331.3	2.73E+01	9.04E+03	5.40E-14	4.88E-10
Uranium-233,234 (pCi/liter)	0.73	2.73E+01	1.99E+01	1.60E-11	3.19E-10
Uranium-238 (pCi/liter)	0.59	2.73E+01	1.61E+01	2.00E-11	3.22E-10
TOTAL					1.61E-07

**CARCINOGENIC RISK (MAXIMUM EXPOSURE)**

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Slope Factor (mg/kg/day) <sup>-01</sup>	Carcinogenic Risk
Benzene	0.002	1.53E-05	3.05E-08	2.90E-02	8.85E-10
Chloromethane	0.007	1.53E-05	1.07E-07	1.30E-02	1.39E-09
Methylene Chloride	0.19	1.53E-05	2.90E-06	7.50E-03	2.18E-08
Trichloroethylene	0.004	1.53E-05	6.11E-08	1.10E-02	6.72E-10
Vinyl Chloride	0.011	1.53E-05	1.68E-07	1.90E+00	3.19E-07
Manganese	2.49	1.53E-05	3.80E-05	NTF	
Zinc	16	1.53E-05	2.44E-04	NTF	
Plutonium-238 (pCi/liter)	0.0022	2.73E+01	6.01E-02	2.20E-10	1.32E-11
Radium-226 (pCi/liter)	0.58	2.73E+01	1.58E+01	1.20E-10	1.90E-09
H-3 (pCi/liter)	1500	2.73E+01	4.10E+04	5.40E-14	2.21E-09
Uranium-233,234 (pCi/liter)	4.2	2.73E+01	1.15E+02	1.60E-11	1.83E-09
Uranium-238 (pCi/liter)	3.76	2.73E+01	1.03E+02	2.00E-11	2.05E-09
TOTAL					3.52E-07

# ATTACHMENT 7 - SELECTION OF SEDIMENT COCS FOR EAST LANDFILL POND RISK ANALYSIS

Analyte	Maximum Concentration	Detection Frequency	Normal Background UTL <sub>99/99</sub> (1)	Sediment PPRG (2)	Analyte Considered a COC?	Rationale
<b>Metals (in mg/kg):</b>						
Aluminum	16,600	2/2	29,600	NA	No	<Background UTL <sub>99/99</sub>
Arsenic	5	3/3	67	NA	No	<Background UTL <sub>99/99</sub>
Barium	215	3/3	795	NA	No	<Background UTL <sub>99/99</sub>
Beryllium	1.5	3/3	2.6	NA	No	<Background UTL <sub>99/99</sub>
Calcium	7,850	2/2	80,900	NA	No	<Background UTL <sub>99/99</sub>
Chromium	17.5	3/3	29.5	NA	No	<Background UTL <sub>99/99</sub>
Copper	18.6	3/3	175.4	NA	No	<Background UTL <sub>99/99</sub>
Iron	15,400	2/2	143,900	NA	No	<Background UTL <sub>99/99</sub>
Lead	33.7	3/3	261.1	NA	No	<Background UTL <sub>99/99</sub>
Magnesium	3,250	2/2	6,470	NA	No	<Background UTL <sub>99/99</sub>
Nickel	15.3	3/3	35.2	NA	No	<Background UTL <sub>99/99</sub>
Potassium	2,640	2/2	3,227	NA	No	<Background UTL <sub>99/99</sub>
Selenium	1.1	3/3	5.2	NA	No	<Background UTL <sub>99/99</sub>
Sodium	447	2/2	2,127	NA	No	<Background UTL <sub>99/99</sub>
Strontium	61.5	2/2	356	NA	No	<Background UTL <sub>99/99</sub>
Vanadium	41	3/3	86.0	NA	No	<Background UTL <sub>99/99</sub>
Zinc	187	3/3	148	>1E+06	No	<Sediment PPRG
<b>Radionuclides (in pCi/g):</b>						
Cesium-137	0.732	3/3	3.51	NA	No	<Background UTL <sub>99/99</sub>
<b>Volatile Organic Compounds (in mg/kg):</b>						
Acetone	0.13	2/3	NA	>1E+06	No	<Sediment PPRG
2-Butanone	0.035	1/3	NA	>1E+06	No	<Sediment PPRG
Toluene	0.44	3/3	NA	>1E+06	No	<Sediment PPRG
<b>Semivolatile Organic Compounds (in mg/kg):</b>						
Acenaphthene	0.1	1/3	NA	>1E+06	No	<Sediment PPRG
Acenaphthylene	0.18	2/3	NA	NA	No	No toxicity factors
Anthracene	0.16	1/3	NA	>1E+06	No	<Sediment PPRG
Benzo(a)anthracene	0.34	1/3	NA	2.33E+02	No	<Sediment PPRG
Benzo(a)pyrene	0.32	1/3	NA	2.33E+01	No	<Sediment PPRG
Benzo(b)fluoranthene	0.45	1/3	NA	2.33E+02	No	<Sediment PPRG
Benzo(ghi)perylene	0.2	1/3	NA	NA	No	No toxicity factors
Benzo(k)fluoranthene	0.13	1/3	NA	2.33E+03	No	<Sediment PPRG
Benzoic acid	0.87	3/3	NA	>1E+06	No	<Sediment PPRG
bis(2-Chloroisopropyl)ether	0.047	1/3	NA	2.43E+03	No	<Sediment PPRG
bis(2-Ethylhexyl)phthalate	0.08	1/3	NA	1.22E+04	No	<Sediment PPRG
Chrysene	0.31	1/3	NA	2.33E+04	No	<Sediment PPRG
Fluoranthene	0.83	2/3	NA	>1E+06	No	<Sediment PPRG
Fluorene	0.092	1/3	NA	>1E+06	No	<Sediment PPRG
Indeno(1,2,3-cd)pyrene	0.18	1/3	NA	2.33E+02	No	<Sediment PPRG
Phenanthrene	0.73	2/3	NA	NA	No	No toxicity factors
Pyrene	0.75	2/3	NA	>1E+06	No	<Sediment PPRG

COCs = Chemicals of concern.

UTL<sub>99/99</sub> = Upper tolerance limit of the 99th percentile at the 99% confidence level.

PPRG = Programmatic preliminary remediation goal.

(1) Statistical background comparisons were not performed due to the small OU7 sample size (3). Rather, the maximum concentration of each analyte was compared to the background UTL<sub>99/99</sub> concentration for seep sediments; background pond sediment samples were not collected. Background samples are assumed to be normally distributed since this is the most conservative assumption.

(2) All organic constituents and inorganics exceeding their respective background UTL<sub>99/99</sub> are compared to the sediment PPRG developed using a residential/recreational RME exposure scenario (see attached).

NA = Not applicable.

# RISK ASSESSMENT PATHWAY ANALYSIS

Attachment 6

## NONCARCINOGENIC RISK (AVERAGE EXPOSURE)

Chemical	Average Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	0.0019	3.56E-05	6.77E-08	NTF	
Chloromethane	0.0051	3.56E-05	1.82E-07	NTF	
Methylene Chloride	0.015	3.56E-05	5.34E-07	6.00E-02	8.90E-06
Trichloroethylene	0.0022	3.56E-05	7.84E-08	NTF	
Vinyl Chloride	0.0053	3.56E-05	1.89E-07	NTF	
Manganese	1.61	3.56E-05	5.73E-05	5.00E-03	1.15E-02
Zinc	2.95	3.56E-05	1.05E-04	3.00E-01	3.50E-04
HAZARD INDEX					1.18E-02

## NONCARCINOGENIC RISK (MAXIMUM EXPOSURE)

Chemical	Maximum Chemical Concentration (mg/liter)	Intake Factor (liter/kg/day) or (liter)	Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	0.002	3.56E-05	7.12E-08	NTF	
Chloromethane	0.007	3.56E-05	2.49E-07	NTF	
Methylene Chloride	0.19	3.56E-05	6.77E-06	6.00E-02	1.13E-04
Trichloroethylene	0.004	3.56E-05	1.42E-07	NTF	
Vinyl Chloride	0.011	3.56E-05	3.92E-07	NTF	
Manganese	2.49	3.56E-05	8.87E-05	5.00E-03	1.77E-02
Zinc	16	3.56E-05	5.70E-04	3.00E-01	1.90E-03
HAZARD INDEX					1.97E-02

NTF - No Toxicity Factor Available

